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(58) Field of search
UK CL (Edition L) A3V, B5A
INT CL[5] A41H 43/00
Online databases: WPI

(54) Rapid clothing manufacture

(57) A process for the rapid manufacture of clothing, e.g. panties and bra, by mass production techniques is based upon the use of a body-form 10 which is hollow, but has walls which are in part polished and impermeable 11, and in part porous 13. The porous parts correspond to the shape of garments which are to be made. Suction can be applied to the space within the body-form via a tube 20. By placing the body-form into one or more vessels filled with a fluidised bed of fibres and fluids, and applying a suction pulse or pulses to extract an appropriate volume of fluid, fibres are deposited as a mat of appropriate thickness upon the porous areas. Thereafter the mat is subjected in a separate vessel (43) to a tacking process which joins fibres to each other and converts the mat into a fabric. The tacking process may utilise laser beams, a spray of flexible bonding agents, heating, or electrostatic attraction of droplets of chemically active adhesive. The body-forms are recycled and reused using them in train on a track 25. Variations of detail enable the articles of clothing to be of different forms, of different sizes, of different and varied thickness (14) or with patterns (17), areas of different colour (61), lacelike patterns (17), or button-holes (66), pockets (51), and fullness outside a normal body as in a dress (Fig. 6 not shown).

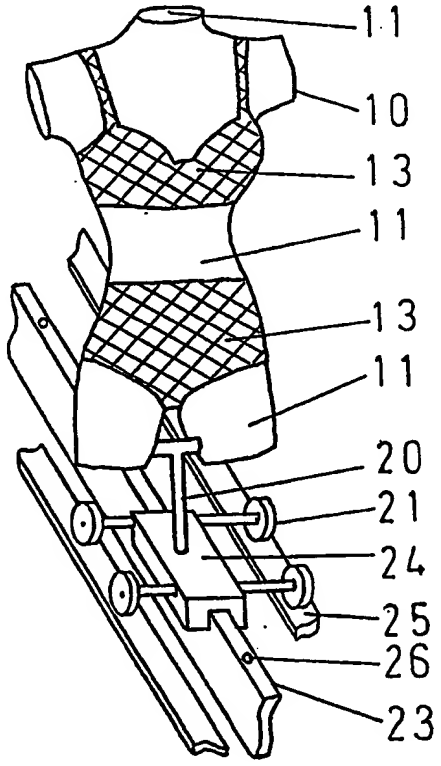

Fig 1

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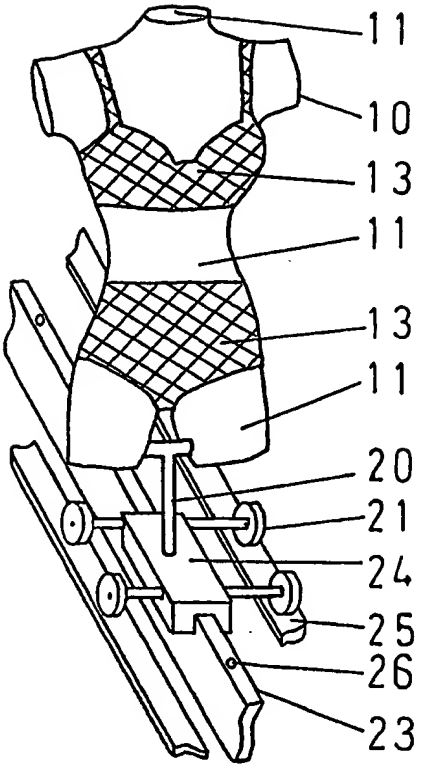

Fig 1

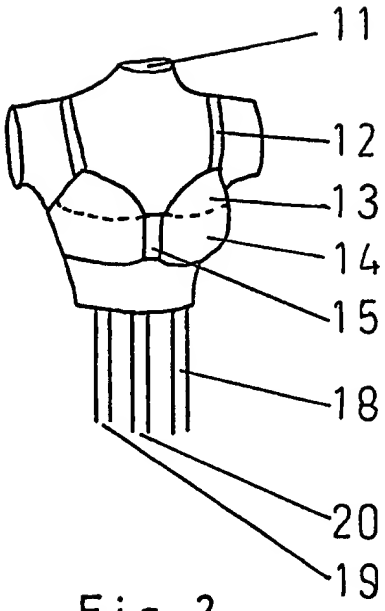

Fig 2

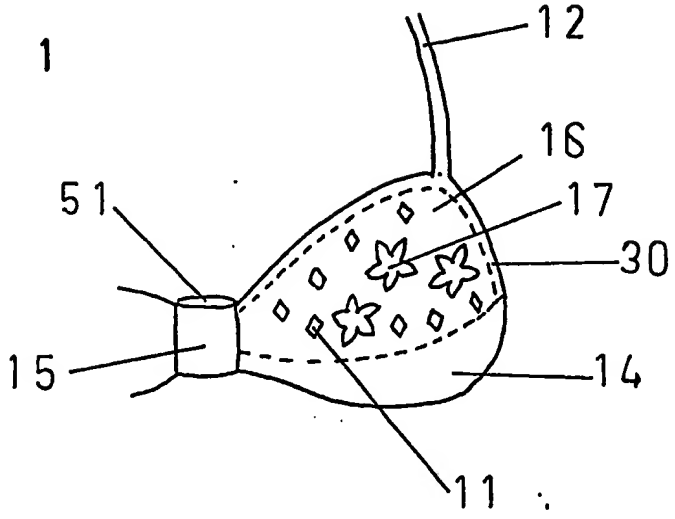

Fig 3

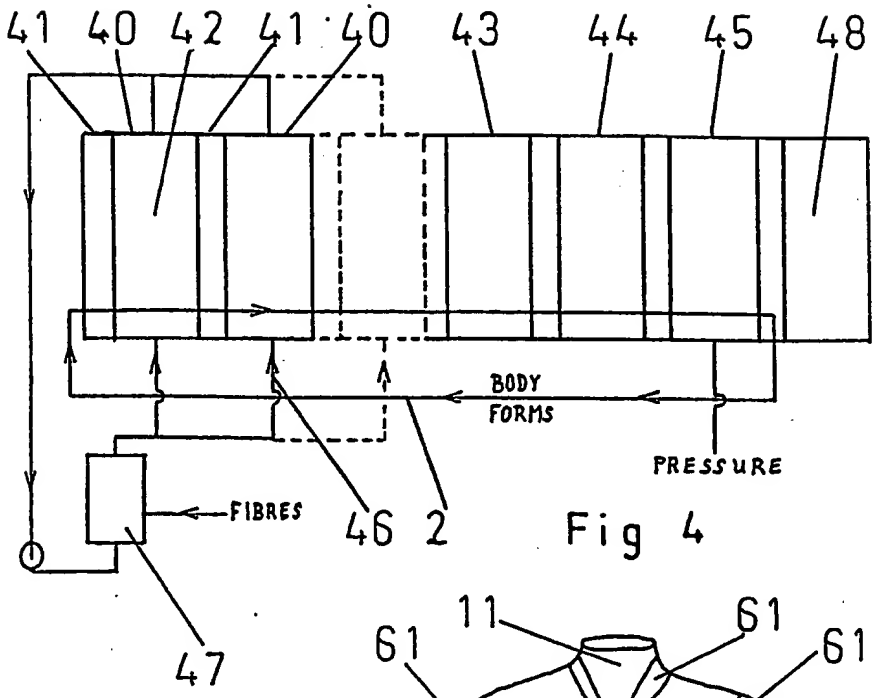

Fig 4

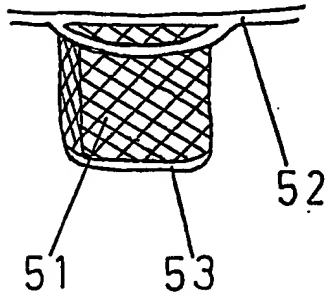

Fig 5

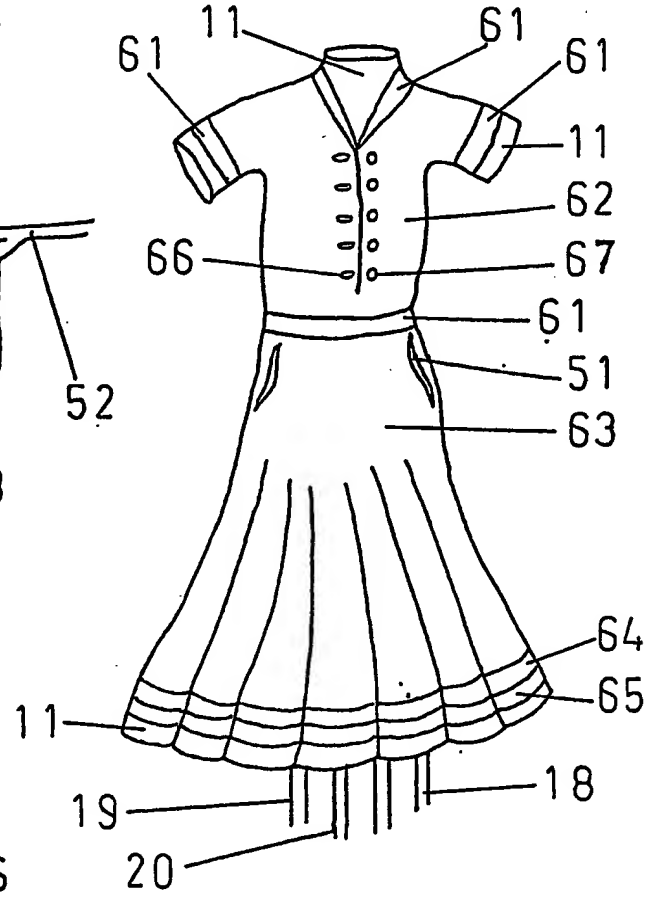

Fig 6

RAPID CLOTHING MANUFACTURE

This invention relates to the manufacture of many types of clothing by use of a rapid technological method.

It is well-known since the Stone Age to create clothing from flat shapes of material both of skins and woven fabrics by stitching them together with needles and threads. It is well-known to make clothing by knitting. It is well-known to make flat material by felting fibres together by wetting shrinking and rolling of matted fibres.

To those skilled in the art of chemical engineering it is well-known to fluidise mixtures of solid particles and liquids or gases, so that solid-liquid or solid-gas mixtures behave as fluids. It is well-known also that such mixtures can be held in fluidised beds or can be sprayed. It is well-known to filter fluids containing solids through porous media, thereby separating them.

Often the manufacture of clothing proceeds through a large number of well-known stages such as carding, spinning, weaving, washing, ironing, cutting, folding, stitching, pressing, and making button-holes. Many of these steps are labour-intensive and involve many man-hours of human effort, and are relatively expensive compared with mass-production technology. The large number of steps also require intermediate stock-piles of materials between steps with consequent costs.

According to the present invention a short but novel series of mechanical operations is used in sequence to provide a process for the rapid production of articles of clothing from natural or synthetic fibres. Starting with chopped fibres of a suitable short length, they are suspended by admixture with a fluid in a fluidised bed. A series of body-forms are provided. Each body-form is in the general shape of the outside surface of a human

or animal body, or part of a body, or a shape derived from a clothed body. It is in the nature of a tailor's dummy, but made of strong solid material in such a way that some parts of the body-form surface are porous. Each body-form is mounted upon a suitable support, which includes one or more tubes fitted at their ends with a valve which may be connected to a source of suction. This may conveniently be a sliding surface which comprises one half of a slide-valve. The clean body-form is moved through a fluid lock into the vessel containing the fluidised bed of fibres. A short suction pulse or series of pulses is applied via the tube(s) to the interior of the body-form. The purpose of the suction pulse(s) is to extract a measured volume of the fluidising fluid through the porous areas of the body-form leaving a fibre mat of appropriate thickness upon those areas. The body-form is later made to pass through a fluid lock into a chamber where there is applied a method of attaching fibre threads to fibre threads. The article of clothing so formed is removed from the body-form, and the body-form is re-used repeatedly.

In order to illustrate the principle, and more detail of the flexibility of the concept by way of example, a specific embodiment of the process is described for the rapid manufacture of panties and brassieres, by reference to the accompanying drawings, in which:-

Figure 1 shows in perspective a simple body-form in the shape of a female torso which can be used to manufacture matching panties and brassiere simultaneously. It includes a suction tube and slide-valve, with mountings on a track.

Figure 2 shows in more detailed perspective a similar body-form of the upper female torso, showing areas of varying porosity and with a variety of suction connections.

Figure 3 shows in more detailed perspective the design of part of a body-form with means of providing patterns and padding in a brassiere cup.

Figure 4 shows a flow diagram illustrating a sequence of suitable manufacturing operations for a complete production line.

Figure 5 illustrates an example of a re-entrant shape which can be made to form a small pocket.

Figure 6 illustrates an example of a body-form developed from a human body shape for the production of a garment which is loose-fitting and exhibits style.

Referring first to Figure 1 of the drawings, the body-form 10 is composed of a rigid solid, such as metal, to form a hollow three-dimensional space enclosed on all sides by rigid surfaces. Some surfaces are polished and impermeable to fluid such as a gas and are indicated by areas 11 which are shown unhatched. Some surfaces are porous to gas as indicated by areas 13 which are shown hatched. Such porous surfaces may be composed for example of sintered metal, fine wire mesh, perforated sheet or woven fabric lightly impregnated and cured by synthetic chemical resin. The volume within the outer walls of the body-form 10 is connected to tube 20 by means of which gas can be drawn by suction through the porous surfaces 13 of the body-form 10. The end of the tube 20 carries one side of a slide-valve 24. The body-form 10 together with the tube 20 and slide-valve 24 are mounted by supports (not shown) upon a carriage along a horizontal track 25 in the manner commonly used on a mass-production assembly line, indicated simply by wheels or slides 21 in Figure 1. The track 25 is associated with a horizontal main suction duct 23 which is provided with suction port-holes 26, which are in the form of the matching second side of a slide-valve so that parts 24 and 26 can mate up in juxtaposition. By a suitable pattern of port-holes 26 suction may be achieved more than once if desired as the carriage moves forward along the track 20. The suction may be controlled alternatively by time-sequenced opening or closing of flow-control valves associated with each port-hole 26. Thus a controlled means of extracting gas through the porous surfaces 13 is ensured. The quantity of gas withdrawn is to be controlled and related to the density of fibres in the fluidised bed(s) 42 of mixed fibres and gas and the area of the porous surface and the thickness of the fibre fabric which is desired to be deposited onto the porous surface.

Referring to **Figures 2 and 3** of the drawings, the porosity of the porous surfaces 12,13,14,15,16,17 may with advantage be different in the different areas of the surface of the body-form. In such a case it is possible to deposit different thicknesses of fabric in different parts of a garment such as, for example, a brassiere, by use of single suction pulse in a single fluidised bed, thicker fabric being formed on the most porous surfaces 14 and thinner fabric being formed on the less porous surfaces, e.g. 13. Additionally, it is possible with advantage to segregate the interior spaces behind the porous areas inside the body-form by using partitions (not shown) and to connect each interior space to a separate gas extraction tube. For example areas 13 may be connected to tube 20 as previously described, while area 14 may be connected to an additional tube 18 through which an earlier or later suction pulse may be used to build up padding on the underside 14 of the brassiere cup. Areas 12 and/or 15 for example could be connected to tube 19, so that when exposed to suction in a separate fluidised bed of elastomer fibres an area within the garment has desirable elastic properties. In such a case the slide-valves on tubes 18, 19 and 20 may with advantage be associated with different but parallel main suction ducts and different port-holes. The necessary separation of specific volumes of space behind specific areas of porosity may be achieved, for example by using a second smaller internal body-form (not shown), and subdividing the interstitial space by patterned barriers in the nature of biscuit cutters.

Referring to **Figure 3** of the drawings it is evident that the principle previously described may be used to produce patterns of advantage to the world of fashion. Area 30 may consist of a graded porosity giving a thinner edge and outline and skin-fit to the brassiere cup. Area 17 may, for example, be flower-shaped, and of a different colour. Area 11 may be non-porous and produce ventilation in the finished fabric or a pattern reminiscent of lace. A closer representation of lace may be obtained by printing a pattern of a sealing agent onto a porous area where holes in the fabric are desired.

Referring to Figure 4 a flow diagram is shown indicating the method of use of body-forms previously described in a continuous automated production process. The body-forms 10 pass in sequence along a track 25 in the direction indicated by arrows through a gas lock 41 into a vessel 40 filled with a fluidised bed 42 of chopped fibres in which the fibres are dispersed and supported by an upward flow of gas 46. It is evident that the gas and fibres must be chemically compatible to avoid fire or explosion. It may be advantageous to arrange for the fibres to be slightly electrostatically charged to assist their dispersal. The fibres may sometimes with advantage be of more than one type. By means previously described a pulse of the dispersant gas is extracted from each body-form in turn causing the formation of fibre mats upon porous areas in the shape of the desired garment. The body-form moves forward through a gas-lock 41 into a second vessel 40, if desired, containing a second fluidised bed of the same or different fibres, receiving if desired a second deposition of fibres. The fluidised bed vessels and gas locks may or may not be repeated as desired. The body-forms pass forward into a tacking chamber 43 in which the fibres in the mats are treated to bond fibres to fibres to form a fabric. Various techniques may be used. For example laser beams transmitting intermittently via rapidly-moving mirrors, or a spray of flexible bonding agents through automated guns or by heating fibre mats which include a proportion of lower-melting fibres, or electrostatically attracting droplets of controlled size of a chemically active adhesive. The body-forms then pass if desired to a curing zone 44 in which the transit time allows the bonding of fibres to continue to completion. The body-forms pass, if desired, to a discharge zone 45 in which a positive pressure pulse is applied to blow the garment off the body-form. Zone 48 is provided for augmentation of the garment by conventional fastenings or differencing to suit the fashion trade. The movements of body-forms may with advantage be controlled by connecting their carriages flexibly together into a train. The body-forms may with advantage be of different sizes and of different shapes, but each being mounted on a common design of carriage and slide-valves.

The principal flows of fibres, fluids and body-forms are shown in **Figure 4** in a style familiar to those skilled in the arts of chemical engineering, in which arrows indicate direction. The Figure is not to be construed as being spatially significant. For example, the track 25 could be above and inverted or designed to dip body-forms into tanks of liquid fluidised beds. Vessels 47 are provided for the preparation and storage of fluidised mixtures of fibres and fluids. Gas-locks or weirs for liquids 41 are provided to allow ingress and exit of body-forms to fluidised beds 42.

A second specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings.

Referring to **Figure 5**, it is possible to use a re-entrant porous shape so that for example the application of suction to a re-entrant surface 51 in which the two opposite sides are parallel and fairly close together will form a pocket within a garment. By analogy it is possible to provide overlap of two porous surfaces having a non-porous strip to form an opening in a Y-front male under-garment. The edges of the re-entrant fabric shape produced may with advantage be strengthened by employing strips on the body-form at areas 52 and 53 which have higher porosity or different fibre composition deposited at the front and rear of the re-entrant zone, thereby providing thicker or stronger reinforcement at the edges of the pocket.

A third specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings.

Referring to **Figure 6** which shows a dress-pattern shape it is possible to use a body-form derived from the shape of the human body but extensively modified to avoid a close-fitting garment, and to provide fullness and shapes appropriate to comfort and colour patterns and fashion in a garment. The body-form at areas marked 11 is non-porous.

At area 61 the body-form is porous employing one colour, at area 62 it is porous using a second colour, at area 63 the body-form is porous in a pattern of several areas varying in porosity and employing several colours. In the lower part of the skirt of the body-form fullness is provided in the garment by draping the surface of the body-form. At 64 the false hem is of one colour repeating a colour of the patterned area 63. At 65 is a band of highly porous surface which will provide weight and satisfactory drape of the finished garment. At areas 66 there is a non-porous area which will produce a button-hole, which may be associated with a surrounding highly porous area to form a reinforced edge to the button-hole. At areas 67 there is an area of higher porosity creating a reinforcement for attachment of a button. At 51 are shown two re-entrant porous surfaces with high porosity strips to provide pockets with reinforcement on the inside of the garment. Tubes 18, 19, 20 etc. provide suction to the various areas as appropriate.

CLAIMS

1. A process for manufacturing an article of clothing, which comprises forming a fluidised bed of fibres in a fluidising fluid, placing in a former in the fluidised bed, the former having an internal chamber in fluid communication with a porous surface region of the former, applying a negative pressure to said chamber to draw the fluidising fluid through said porous region and deposit a layer of fibres on said porous surface region in the shape of said article.

2. A process according to Claim 1, in which the negative pressure is applied as a short pulse or series of pulses.

3. A process according to Claim 1 or 2, which comprises removing the former from the fluidised bed whilst carrying said layer of fibres, inserting the former into a second fluidised bed of fibres in a fluidising fluid, and applying a negative pressure to said chamber, or a second chamber, to draw the fluidising fluid through said porous region, or a second porous region, and deposit a further layer of fibres onto said former.

4. A process according to any preceding claim, which comprises subjecting said layer of fibres to a bonding process to bond the fibres together.

5. A process according to Claim 4, in which the bonding process utilises laser light to bond the fibres together.

6. A process according to Claim 4, in which the bonding process comprises applying droplets of a liquid bonding agent to said layer of fibres.

7. A process according to Claim 6, in which said droplets are applied by spraying.

8. A process according to Claim 6, in which said droplets are applied by electrostatic attraction.

9. A process according to Claim 4, in which said fluidised bed comprises a solid bonding component of a lower melting point to said fibres, and said bonding process comprises application of heat to said layer sufficient to melt said bonding component.

10. A process according to any of Claims 4 to 9, in which, following said bonding process, the bonded layer is removed from said former by application of a positive pressure to said chamber.

11. A process according to any preceding claim, in which said fluidising fluid is a liquid.

12. A process according to any preceding claim, in which said fluidising fluid is a gas.

13. Apparatus for manufacturing an article of clothing, which comprises a fluidised bed of fibres in a fluidising fluid, a former having an internal chamber in fluid communication with a porous surface region of said former, and means for applying a negative pressure to said chamber to draw the

fluidising fluid through said porous region and deposit a layer of fibres on said porous surface region in the shape of said article.

14. Apparatus according to Claim 13, in which the former comprises a surface region which is substantially impermeable to said fluidising fluid.

15. Apparatus according to Claim 14, in which said impermeable surface region is smooth.

16. Apparatus according to Claim 13 or 14, in which said porous surface region includes a re-entrant area.

17. Apparatus according to any of Claims 13 to 16, in which said porous surface region includes sub-regions of differing porosity.

18. Apparatus according to any of Claims 13 to 17, in which said porous surface region includes sub-regions connected to respective separate chambers within said former.

19. Apparatus according to any of Claims 13 to 18, in which said former comprises a plurality of mutually separate porous surface regions for forming a plurality of separate articles of clothing thereon.

20. Apparatus according to any of Claims 13 to 19, in which said means for applying a negative pressure is adapted to apply a short pulse or series of negative pressure pulses to said chamber.

21. Apparatus according to Claim 20, in which said means for

applying a negative pressure comprises valve means for controlling the application of negative pressure to said chamber.

22. Apparatus according to any of Claims 13 to 21, in which said former is arranged to move through said fluidised bed along a track.

23. Apparatus according to Claim 22, in which the track is formed in a continuous loop.

24. Apparatus according to Claim 22 or 23, in which a train of such formers are arranged to move along said track.

25. Apparatus according to Claim 22, 23 or 24, in which the track is associated with a negative pressure duct having ports arranged to communicate with said chamber as the former moves along said track.

26. Apparatus according to any of Claims 13 to 25, in which said fluidised bed is contained within a vessel and the former is arranged to pass into and out of said vessel via respective fluid locks.

27. Apparatus according to any of Claims 13 to 26, including one or more further fluidised beds for application of a further layer or layers of fibres to said former.

28. Apparatus according to any of Claims 13 to 27, in which the apparatus comprises a bonding area for receiving said former whilst carrying said layer of fibres, and the bonding area is provided with means for bonding said fibres together.

29. Apparatus according to Claim 28, in which the bonding means comprises a source of laser light.

30. Apparatus according to Claim 28, in which the bonding means is arranged for applying droplets of a liquid bonding agent to said layer of fibres.

31. Apparatus according to Claim 30, in which said bonding means comprises a spray outlet for creating said droplets.

32. Apparatus according to Claim 30, in which said bonding means comprises electrostatic generating means for depositing said droplets on said layer of fibres by electrostatic attraction.

33. Apparatus according to Claim 30, in which said fluidised bed comprises a solid bonding component of a lower melting point to said fibres, and said bonding means comprises heating means for application of heat to said layer sufficient melt said bonding component.

34. Apparatus according to any of Claims 13 to 33, comprising means for applying a positive pressure to said chamber to remove the bonded layer from the former.

35. Apparatus according to any of Claims 13 to 34, in which said fluidising fluid is a liquid.

36. Apparatus according to any of Claims 13 to 34, in which said fluidising fluid is a gas.

37. A process for manufacturing an article of clothing, substantially as described with reference to the drawings.

38. Apparatus for manufacturing an article of clothing, substantially as described with reference to the drawings.

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Patents Act 1977
Examiner's Report to the Comptroller under Section 17 (The Search Report)

Application number: GB 9305753.7

Relevant Technical fields

(i) UK Cl (Edition L) A3V; B5A

(ii) Int Cl (Edition 5) A41H 43/00

Search Examiner: D BUCKLEY

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search: 2 JUNE 1993

Documents considered relevant following a search in respect of claims ALL

Category (see over)	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2204525 A	(PAL INTERNATIONAL) whole document but see, eg, lines 4-5 of page 3 and lines 11-12 of page 5	1,4,9,10, 12,13,34 & 36 at least
X	GB 2186183 A	(PALL CORPORATION) whole document	1,4,11, 13,14,15 & 35 at least
X	GB 2074085 A	(TELFORD SAFETY GLOVE) whole document	1,4,10, 13,14,15, 28,34 & 35 at least
X	GB 1411438	(WIGGINS TEAPE--) whole document but see, eg, lines 22-24 of page 2 and lines 74-110 of page 3	1,3,4,10, 11,13,14, 15,17,27, 34,35 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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P: Document published on or after the declared priority date but before the filing date of the present application.

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